

Appendix J
Technical Memorandum on Proposed
Flood Retention Facility
Pre-construction Vegetation
Management Plan

CHEHALIS BASIN STRATEGY TECHNICAL MEMORANDUM

Date: August 31, 2016
To: Bob Montgomery and Greg Summers, Anchor QEA, LLC
From: Matt Kuziinsky, Adam Hill, and Erik Pipkin, Anchor QEA, LLC
Cc: Heather Page, Anchor QEA, LLC
Re: Proposed Flood Retention Facility Pre-construction Vegetation Management Plan

Introduction

This technical memorandum presents a potential pre-construction vegetation management plan for the Flood Retention Facility action element being considered under the Chehalis Basin Strategy Governor's Work Group Recommendation Alternative.

Anchor QEA, LLC, looked at the option of limiting the extent of vegetation removal in the reservoir footprint and minimizing ongoing vegetation management efforts once the facility is in operation. Discussions with agency staff from the Washington Department of Fish and Wildlife and the Washington Department of Natural Resources and operations personnel at the U.S. Army Corps of Engineers' Mud Mountain Dam and Howard A. Hanson Dam facilities supported a limited vegetation management plan; neither of these facilities include vegetation management activities in their operating plans. Though both of these sites were likely cleared prior to dam construction (1939 to 1948 for Mud Mountain Dam and 1959 to 1962 for Howard A. Hanson Dam), no major tree removal actions have been required in the 68 years that Mud Mountain Dam or in the 54 years that Howard A. Hanson Dam have been in operation.

Pre-construction Vegetation Management Plan

The pre-construction vegetation management plan described herein for the two Chehalis Basin Strategy Flood Retention Facility options (flood retention only [FRO] and flood retention flow augmentation [FRFA]) is designed to retain and allow the development of various vegetation community types in four to five specific zones, based on the expected duration of inundation during flood retention operations, while allowing the removal of some of the harvestable timber from the project area during construction. The proposed goals of this plan are as follows:

- Reduce potential for future damage to dam facilities (e.g., intake structure, flood gates) by floating woody material from dead remnant trees in the reservoir footprint that may come loose from the ground following prolonged inundation

- Reduce the amount of woody material that would accumulate in the reservoir during a flood
- Remove vegetation that could pose a hazard to dam operations personnel, especially those responsible for wood material collection and transport
- Maintain some level of riparian zone function along the river and its tributaries in the reservoir footprint to provide fish and wildlife habitat
- Minimize the extent of vegetation removal to reduce the potential for erosion along river and stream banks within the reservoir footprint
- Harvest marketable timber in areas where projected inundation depths and durations would be expected to kill tree species that do not tolerate extended flooding

This pre-construction vegetation management plan would be implemented during the construction phase of the Flood Retention Facility. Vegetation management actions during facility operation would be covered in a separate vegetation management plan for facility operations, the scope of which is briefly discussed at the end of this technical memorandum.

Inundation Zones

The inundation zones that this proposed pre-construction vegetation management plan is based on are as follows:

- Flooded every year; will be under water on average greater than 76 days per year (FRFA only)
- 10% chance of being flooded in a year (10-year event); will be under water for 25 days per year when flooded (FRO and FRFA)
- 5% chance of being flooded in a year (20-year event); will be under water for 4 days per year when flooded (FRO and FRFA)
- 1% chance of being flooded in a year (100-year event); will be under water for 1 day per year when flooded (FRO and FRFA)
- <1% chance of being flooded in a year (>100-year event; FRO and FRFA)

The inundation elevations used to define these inundation zones are different for each Flood Retention Facility option and were based on HEC-ResSim modeling results that simulated reservoir operations using synthetic flows expected for the 10% annual chance (10-year), 5% annual chance (20-year), and 1% annual chance (100-year) events. The peak elevation for each event was set as the upper bound for its corresponding zone. For the FRFA, it was assumed that the conservation pool (elevation 627 feet North American Vertical Datum of 1988 [NAVD88]) was full when a storm event occurred.

Tables 1 and 2 show the elevation of each inundation zone, the proposed pre-construction management actions that would be implemented in each zone, and the expected vegetation community type and vegetation that would be present in each zone after facility construction and operation. Figures 1 and 2 show the expected extent of each vegetation community type for the FRO and FRFA, respectively.

Pre-construction Management Actions

Prior to construction, woody vegetation would be completely cleared from the dam site and from any areas where temporary construction access would be required. Additionally, for the FRFA, woody vegetation would be completely cleared within the management pool area (i.e., the areas that would be inundated every year for flow augmentation purposes). Within the temporary reservoir footprint, clearing would be much more limited. For both the FRO and FRFA, all non-flood tolerant tree species would be removed from the zone where inundation duration is expected to last 25 days or more when the reservoir is storing water (Tables 1 and 2). For this plan, non-flood tolerant tree species are defined as those species that are unable to survive more than a few days of flooding during the growing season without significant mortality (Whitlow and Harris 1979).

Flood tolerance ratings for trees for this plan are partially based on information provided in Whitlow and Harris's 1979 article, *Flood Tolerance in Plants: A State-of-the-Art Review*, which was published by the U.S. Army Corps of Engineers Waterways Experiment Station (Table 3). As indicated in Table 3, common non-flood tolerant tree species identified in this document for the Pacific Northwest include Douglas fir (*Pseudotsuga menziesii*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and bitter cherry (*Prunus emarginata*). Although Whitlow and Harris consider red alder to be intolerant of flooding, other sources (Minore 1968; DeBell and Turpin 1983; Harrington 2006) have found that this species can tolerate some flooding. Wenger (1984) identifies red alder as being moderately tolerant of flooding and provides flood tolerance rankings for a similar list of western trees as Whitlow and Harris (Table 3). Wenger notes that flood tolerance generally increases with tree age and size up to maturity. Although the flood tolerance ratings from these sources differ slightly, both are in agreement that Douglas fir will not survive flooding that is more than a few days in duration.

The pre-construction management actions proposed in this plan for the FRO and FRFA would be developed in coordination with the Washington Department of Natural Resources. Proposed management actions would potentially include the removal of commercial timber from existing Washington Department of Natural Resources-defined riparian management zones (RMZs) along sections of the Chehalis River and tributaries in the reservoir footprint. This approach would primarily target all Douglas fir in the RMZ, as this species would not be expected to survive in this inundation zone. For the remaining zones where inundation duration would range from 1 to 4 days when flooded, no harvesting would occur. Depending on inundation timing and duration, some of the remnant non-flood tolerant trees may eventually die and go on to provide wildlife habitat as both snags and downed woody material. The uppermost inundation zone of the reservoir footprint would be left as a predominantly coniferous forest.

Table 1
Expected Vegetation Community Types by Inundation Zone in the Flood Retention Only Reservoir

INUNDATION ZONE	ELEVATION RANGE (FEET)¹	PRE-CONSTRUCTION MANAGEMENT ACTIONS²	AREA (ACRES)³	EXPECTED POST-CONSTRUCTION VEGETATION COMMUNITY TYPE AND TYPICAL VEGETATION
10% chance of being flooded in a year (10-year event); will be under water for 25 days when flooded	424 – 567	Selectively harvested to remove non-flood tolerant species ⁴	405	Deciduous Riparian Shrubland – various willows, red-osier dogwood, potential emergent/scrub-shrub wetlands
5% chance of being flooded in a year (20-year event); will be under water for 4 days when flooded	567 – 584	No harvest	80	Deciduous Riparian Forest with some Conifers – red alder, western red cedar, Oregon ash, black cottonwood, willows, elderberry, snowberry
1% chance of being flooded in a year (100-year event); will be under water for 1 day when flooded	584 – 612	No harvest	136	Mixed Coniferous/Deciduous Transitional Forest – Douglas fir (young), red alder, bigleaf maple
<1% chance of being flooded in a year (>100-year event)	612 – 627	No harvest	90	Coniferous Forest – Douglas fir

Notes:

1. North American Vertical Datum of 1988 (NAVD88).
2. These management actions may be either periodically repeated on a regular management cycle (e.g., every 20 years) or as needed.
3. Note that vegetated area extents are only those areas that are currently vegetated and do not include roads or non-vegetated land (e.g., stream channels).
4. It is assumed that the Washington Department of Natural Resources would allow the removal of non-flood tolerant trees from the RMZ in this portion of the reservoir footprint.

Table 2

Expected Vegetation Community Types by Inundation Zone in the Flood Retention Flow Augmentation Reservoir

INUNDATION ZONE	ELEVATION RANGE (FEET) ¹	PRE-CONSTRUCTION MANAGEMENT ACTIONS ²	AREA (ACRES) ³	EXPECTED POST-CONSTRUCTION VEGETATION COMMUNITY TYPE AND TYPICAL VEGETATION
Flooded every year; will be under water on average greater than 76 days when flooded	424 – 627	Clear-cut	711	Aquatic – largely unvegetated
10% chance of being flooded in a year (10-year event); will be under water for 25 days when flooded	627 – 653	Selectively harvested to remove non-flood tolerant species ⁴	178	Deciduous Riparian Shrubland – various willows, red-osier dogwood, potential emergent/scrub-shrub wetlands
5% chance of being flooded in a year (20-year event); will be under water for 4 days when flooded	653 – 661	No harvest	56	Deciduous Riparian Forest with some Conifers – red alder, western red cedar, Oregon ash, black cottonwood, willows, elderberry, snowberry
1% chance of being flooded in a year (100-year event); will be under water for 1 day when flooded	661 – 678	No harvest	134	Mixed Coniferous/ Deciduous Transitional Forest – Douglas fir (young), red alder, bigleaf maple
<1% chance of being flooded in a year (>100-year event)	678 – 687	No harvest	72	Coniferous Forest – Douglas fir

Notes:

1. North American Vertical Datum of 1988 (NAVD88).
2. These management actions may be either periodically repeated on a regular management cycle (e.g., every 20 years) or as needed.
3. Note that vegetated area extents are only those areas that are currently vegetated and do not include roads or non-vegetated land (e.g., stream channels).
4. It is assumed that the Washington Department of Natural Resources would allow the removal non-flood tolerant trees from the RMZ in this portion of the reservoir of footprint.

Table 3
Relative Flood Tolerance of Common Native Woody Plants in the Pacific Northwest

COMMON NAME ¹	SCIENTIFIC NAME ¹	FLOOD TOLERANCE RATING	
		WHITLOW AND HARRIS (1979) ²	WENGER (1984) ³
Red-osier dogwood	<i>Cornus sericea</i>	Very tolerant	Not rated
Narrow leaf willow	<i>Salix exigua</i>	Very tolerant	Moderately tolerant
Hooker willow	<i>Salix hookeriana</i>	Very tolerant	Moderately tolerant
Pacific willow	<i>Salix lasiandra</i>	Very tolerant	Moderately tolerant
Lodgepole pine	<i>Pinus contorta</i>	Tolerant	Moderately tolerant
Black cottonwood	<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Tolerant	Moderately tolerant
Red elderberry	<i>Sambucus racemosa</i>	Tolerant	Not rated
Hardhack	<i>Spiraea douglasii</i>	Tolerant	Not rated
Western red cedar	<i>Thuja plicata</i>	Tolerant	Weakly tolerant
Sitka spruce	<i>Picea sitchensis</i>	Slightly tolerant	Weakly tolerant
Ponderosa pine	<i>Pinus ponderosa</i>	Slightly tolerant	Intolerant
Western hemlock	<i>Tsuga heterophylla</i>	Slightly tolerant	Weakly tolerant
Bigleaf maple	<i>Acer macrophyllum</i>	Intolerant	Weakly Tolerant
Red alder	<i>Alnus rubra</i>	Intolerant	Moderately tolerant
Mock orange	<i>Philadelphus</i> L.	Intolerant	Not rated
Bitter cherry	<i>Prunus emarginata</i>	Intolerant	Not rated
Douglas fir	<i>Pseudotsuga menziesii</i>	Intolerant	Intolerant
Cascara	<i>Rhamnus purshiana</i>	Intolerant	Not rated
Oregon ash	<i>Fraxinus latifolia</i>	Not rated	Weakly tolerant

Notes:

Table adapted from Table 21 (Relative Flood Tolerances of Woody Plants, North Pacific Division) in Whitlow and Harris (1979) and Table 4 (Relative Flood Tolerance of Some Tree and Shrub Species of the United States for which Experimental Data are Available) in Wegner (1984).

1. Common and scientific names updated based on U.S. Department of Agriculture, Natural Resources Conservation Service PLANTS Database (2016).
2. Flood Tolerance Ratings (Whitlow and Harris 1979) as follows:
 - Very Tolerant: able to survive deep, prolonged flooding for more than 1 year
 - Tolerant: able to survive deep flooding for one growing season, with significant mortality occurring if flooding is repeated the following year
 - Slightly Tolerant: able to survive flooding or saturated soils for 30 consecutive days during the growing season
 - Intolerant: unable to survive more than a few days of flooding during the growing season without significant mortality
3. Wenger (1984) does not provide definitions for the flood tolerance ratings categories used in Table 4.

Expected Post-construction Vegetation Community Types

For both the FRO and FRFA, the expected post-construction vegetation community types moving upslope from the valley floor would include the following:

- Deciduous riparian shrubland
- Deciduous riparian forest with some conifers
- Mixed deciduous/coniferous transitional forest
- Coniferous forest

In addition to the inundation zones, the FRFA also includes an aquatic zone, which would occur in the area below the upper limits of the conservation pool (elevation 627 feet NAVD88).

The expected woody plants that would be found in each community type were based on flood tolerance ratings for the tree and shrub species most commonly observed on the project site shown in Table 3. In addition to the existing trees and shrubs that would be left in these community types, supplemental native plantings may also be installed in certain areas. Plant selection for these supplemental plantings would be based on the flood-tolerance ratings for seedlings and saplings in accordance with multiple sources, including the U.S. Department of Agriculture, the Natural Resource Conservation Service, (Tilley et al. 2012), and Oregon State University Extension Service (Withrow-Robinson et al. 2011). These ratings included the following categories of flood tolerance:

- Low: tolerates 1 to 5 days or less of inundation (e.g., Douglas fir, vine maple [*Acer circinatum*], and bigleaf maple)
- Medium: tolerates 6 to 10 days of inundation (e.g., red alder, black cottonwood [*Populus balsamifera* ssp. *trichocarpa*], Oregon ash [*Fraxinus latifolia*], red elderberry [*Sambucus racemosa*], and snowberry [*Symphoricarpos albus*])
- High: tolerates 10 to 30+ days of inundation (e.g., red-osier dogwood [*Cornus sericea*], willows, and western red cedar [*Thuja plicata*])

Although the deciduous riparian shrubland community type would not provide the same level of function as the existing conifer-dominated riparian zones, it would provide some degree of riparian functions, including bank stabilization, woody material recruitment, leaf litter fall, nutrient input, sediment filtration, and shading to the Chehalis River and other streams in the reservoir footprint. Adjacent vegetation community types outside of the riparian zone would also serve to support some of these functions (e.g., sediment filtration) as well as provide wildlife habitat.

Facility Operations Vegetation Management Plan

A separate vegetation management plan will be prepared as part of the operations plan for the FRO or FRFA Flood Retention Facility. This vegetation management plan will address the management of vegetation during facility operations and will focus on verifying the safe and efficient operation of the facility as well as the restoration and enhancement of fish and wildlife habitat within the reservoir footprint. The following types of actions will be addressed in the plan:

- Routine vegetation maintenance, including guidelines on what would trigger cutting, trimming, or removal of live vegetation after initial dam construction
- Post-construction re-vegetation efforts
- Post-construction vegetation monitoring
- Adaptive management approaches

A draft plan will be prepared once an alternative is selected by the Office of the Chehalis Basin.

References

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FIGURES

Figure 1
Expected Vegetation Community Type in the Flood Retention Only Reservoir

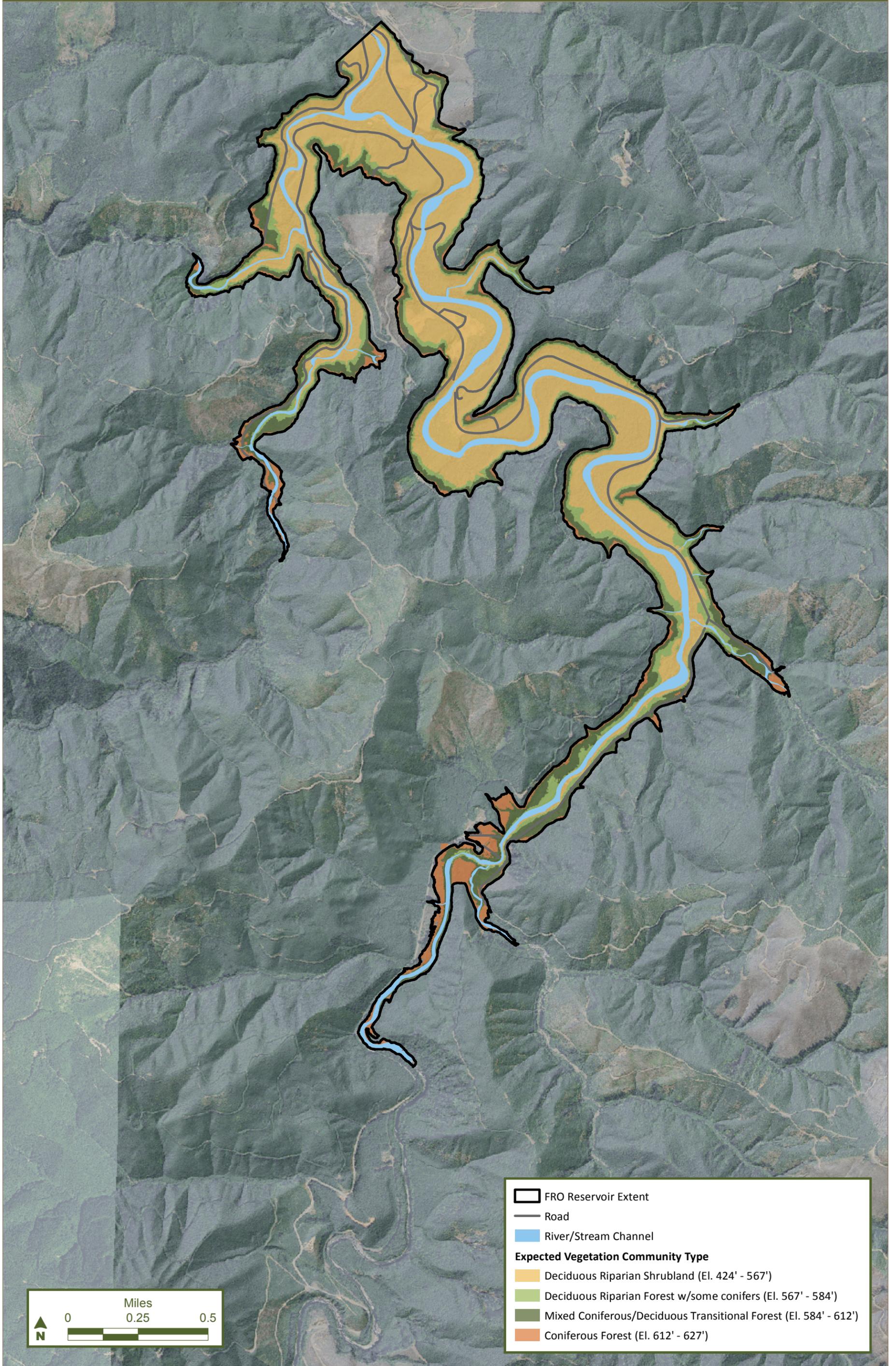


Figure 2
Expected Vegetation Community Type in the Flood Retention Flow Augmentation Reservoir

